

CLAIMS

WHAT IS CLAIMED:

1. A method, comprising:

forming doped regions of a specified doping profile in a silicon region adjacent to a
gate electrode having sidewall spacers formed thereon;

removing a surface layer of said doped regions by performing an etching process
using a diluted etch solution; and

epitaxially growing a silicon layer on said doped regions after said surface layer is
removed.

2. The method of claim 1, wherein said diluted etch solution comprises
hydrogenated fluoride (HF), hydrogen peroxide (H₂O₂) and water.

3. The method of claim 1, wherein said diluted etch solution comprises
ammonium hydroxide and hydrogen peroxide (APM).

4. The method of claim 1, further comprising cleaning said surface layer prior to
removing said surface layer so as to remove oxide residues.

5. The method of claim 2, wherein said etch solution is applied by a spray tool.

6. The method of claim 2, further comprising rinsing said surface layer before or
after applying said diluted etch solution.

7. The method of claim 2, wherein removing said surface layer includes intermittently applying said etch solution and cleaning said surface layer at least once during a discontinuation of etch solution application.

5 8. The method of claim 1, further comprising controlling a thickness of the removed surface layer by determining in advance an etch rate of said etch solution and adjusting an etch time.

10 9. The method of claim 1, further comprising determining a penetration depth of contaminations in said surface layer.

10. The method of claim 1, further comprising adjusting an under-etch of said sidewall spacers during removal of said surface layer.

15 11. The method of claim 1, further comprising forming a metal silicide in said grown silicon layer and said doped regions, wherein an effective lateral dimension is substantially determined by said under-etch.

20 12. The method of claim 1, further comprising oxidizing a portion of said surface layer of said doped regions prior to removing said surface layer by using a diluted oxidizing solution comprising sulfuric acid and hydrogen peroxide (SPM).

13. The method of claim 12, further comprising repeating at least once the step of oxidizing a portion of said surface layer and removing the oxidized portion of said surface layer.

5 14. A method, comprising:

forming doped regions of a specified doping profile in a silicon region adjacent to a gate electrode having sidewall spacers formed thereon;

removing a surface layer of said doped regions by using a diluted etch solution comprising hydrogenated fluoride (HF), hydrogen peroxide (H₂O₂) and water;

10 and

epitaxially growing a silicon layer on said doped regions after said surface layer is removed.

15 15. The method of claim 14, further comprising cleaning said surface layer prior to removing said surface layer so as to remove oxide residues.

16. The method of claim 14, wherein said etch solution is applied by a spray tool.

20 17. The method of claim 14, further comprising rinsing said surface layer before or after applying said diluted etch solution.

25 18. The method of claim 14, wherein removing said surface layer includes intermittently applying said etch solution and cleaning said surface layer at least once during a discontinuation of etch solution application.

19. The method of claim 14, further comprising controlling a thickness of the removed surface layer by determining in advance an etch rate of said etch solution and adjusting an etch time.

5 20. The method of claim 14, further comprising determining a penetration depth of contaminations in said surface layer.

21. The method of claim 14, further comprising adjusting an under-etch of said sidewall spacers during removal of said surface layer.

10 22. The method of claim 14, further comprising forming a metal silicide in said grown silicon layer and said doped regions, wherein an effective lateral dimension is substantially determined by said under-etch.

15 23. A method, comprising:

forming doped regions of a specified doping profile in a silicon region adjacent to a gate electrode having sidewall spacers formed thereon;

removing a surface layer of said doped regions by using a diluted etch solution comprising ammonium hydroxide and hydrogen peroxide (APM); and

20 epitaxially growing a silicon layer on said doped regions after said surface layer is removed.

24. The method of claim 23, further comprising cleaning said surface layer prior to removing said surface layer so as to remove oxide residues.

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25. The method of claim 23, further comprising rinsing said surface layer before or after applying said diluted etch solution.

26. The method of claim 23, further comprising controlling a thickness of the removed surface layer by determining in advance an etch rate of said etch solution and adjusting an etch time.

27. The method of claim 23, further comprising determining a typical penetration depth of contaminations in said surface layer.

28. The method of claim 23, further comprising adjusting an under-etch of said sidewall spacers during removal of said surface layer.

29. The method of claim 23, further comprising forming a metal silicide in said grown silicon layer and said doped regions, wherein an effective lateral dimension is substantially determined by said under-etch.

30. A method, comprising:
forming doped regions of a specified doping profile in a silicon region adjacent to a gate electrode having sidewall spacers formed thereon;
oxidizing a surface layer of said doped regions by using a diluted oxidizing solution comprising sulfuric acid and hydrogen peroxide (SPM);
removing said oxidized surface layer by using a diluted etch solution comprising hydrogenated fluoride (HF); and

epitaxially growing a silicon layer on said doped regions after said oxidized surface layer is removed.

31. The method of claim 30, further comprising repeating at least once the step of oxidizing a surface layer and removing the oxidized surface layer.

32. The method of claim 30, further comprising cleaning a surface of said doped regions prior to epitaxially growing a silicon layer so as to remove residues of said diluted oxidizing solution.

33. The method of claim 32, wherein a diluted etch solution comprising ammonium hydroxide and hydrogen peroxide (APM) is used.

34. The method of claim 33, wherein ultrasound energy is supplied while cleaning the surface.

35. The method of claim 30, wherein an oxidation rate is adjusted by selecting a temperature of said oxidizing solution for a given mixture ratio.

36. The method of claim 30, further comprising cleaning said surface layer prior to removing said surface layer so as to remove oxide residues.

37. The method of claim 30, further comprising determining an oxidation rate and an etch rate in advance and controlling removal of said surface layer by adjusting an oxidation time and an etch time on the basis of the oxidation rate and the etch rate.